# Instructions for Cathode Ray Tube Lab

## A Initial setup

(1) Before connecting the CRT to the power supply, measure the battery voltage. If that voltage is below 4 V, return the battery to your instructor and get a new one.

Now connect the CRT to the power supply and have your instructor check your circuit before turning on the power supply.

(2) Turn up $V_B$ and $V_C$ until you see a focussed spot on the screen. Measure both $V_B$ and $V_C$. What is the total accelerating voltage? How fast are the electrons travelling by the time they reach the deflector plates? (Hint: the work done by the electric field is $e\,\Delta V$).

## B Focussing the beam

(3) Now increase $V_C$. Is the spot on the screen still focussed? Now adjust $V_B$ until the spot refocusses on the screen. Did you have to increase or decrease $V_B$ to refocus the spot?

(4) Repeat the procedure in the previous question several times, each time measuring both $V_C$ and $V_B$ (make sure the spot is focussed when you measure both voltages). Do this over a range of values for both $V_C$ and $V_B$. Plot $V_B$ vs. $V_C$. What is the relationship between these two voltages?

(5) Calculate the slope of this graph and compare your slope with other lab groups. Do all of the CRTs require the same ratio $V_B/V_C$ for focussing the spot?

## C The deflector plates

(6) Connect the vertical plates (1 and 2) to the green power supply and adjust that power supply voltage up and down. What direction does the spot move on the screen when the voltage is increased? Draw a circuit diagram showing the connection between the power supply and the deflector plates. Is your circuit diagram consistent with the motion of the spot on the screen?

(7) Now disconnect the vertical plates and connect the horizontal plates (3 and 4) to the green power supply and repeat the above exercise.

(8) Now connect both the horizontal and vertical plates to the green power supply and repeat the above exercise.

# D Vertical deflection factor (VDF)

(9) Return the setup to vertical deflection only, and measure the deflector voltage for several values of vertical deflection (number of divisions). Plot deflector voltage vs. vertical deflection and calculate the slope of this graph. The slope is called the vertical deflection factor (VDF) and is a measure of how much voltage is required for each division of vertical deflection.

(10) Now reduce the *accelerating voltage* (i.e., $V_C + V_B$) and redetermine the VDF (you don't need to plot a new graph, just take one or two data points and perform a simple calculation). Did the VDF increase, decrease, or remain the same? Can you explain why? (Hint: what happens to the speed of the electrons when you decrease the accelerating voltage?)